Thrombolysis for Acute Limb-Threatening Ischemia: A Practical Approach

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Abstract

Keywords

- thrombolysis
- interventional radiology
- thrombosis
- clot

Lower extremity arterial thrombolysis is a safe and effective means of treating acute limb ischemia due to in situ thrombosis or embolic occlusion. It is optimally used in occlusions of <7 days duration. Proper patient selection is critical to successful outcome. In all patients undergoing successful thrombolysis, it is mandatory to ascertain the etiology of the thrombosis and correct the underlying problem to facilitate a durable outcome.

Objectives: Upon completion of this article, the reader will be able to list the rationale for thrombolysis, contraindications to its use, and common complications of catheter-directed thrombolysis.

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Case Presentation

A 51-year-old man with significant lower extremity arterial occlusive disease presented to the emergency department with acute left lower extremity rest pain. Previous surgical history included a left common femoral to below-knee popliteal artery bypass graft with greater saphenous vein conduit, as well as stent placement across the proximal anastomosis of the bypass performed at an outside hospital.

On physical examination, the patient had no palpable distal pulses in the left leg but intact sensory and motor function. His left foot was cool to touch. The patient was alert and oriented. His complete blood count, prothrombin, partial thromboplastin, fibrinogen, fibrin degradation products, and

international normalized ratio were all within normal limits. He had undergone a type and screen for blood products.

He was taken to the interventional radiology suite and prepped. After right common femoral artery puncture, a pigtail catheter was advanced to the distal abdominal aorta and pelvic angiography was performed that revealed occlusion of the bypass graft as well as an irregular-appearing stenosis of the proximal left external iliac artery (► **Fig. 1**). A 6F 40-cm-long Balkan sheath (Cook Medical Inc., Bloomington, IN) was placed via the right-sided access, and a guidewire was advanced into the proximal left common femoral artery. Pressure measurements were then obtained in both the left common iliac artery via the Balkan sheath and the distal left external iliac artery via a 5F end-hole catheter. A gradient of 14 mm Hg was noted across the complex stenosis in the proximal left external iliac artery.

A total of 3000 units of heparin were administered intra-arterially, and an 8 mm × 4 cm angioplasty balloon catheter (Mustang, Boston Scientific, Natick, MA) was advanced to the left external iliac lesion and inflated. After dilatation, post-angioplasty angiography was performed through the 6F sheath revealing no residual stenosis. Additionally, pressure measurements were repeated and demonstrated equalization of pressures in the common iliac and common femoral arteries.

The occluded bypass graft was catheterized with a 5F end-hole catheter and guidewire. The combination was advanced into the distal graft, and 2 mg of tissue plasminogen activator

Figure 1 Thrombolysis of occluded left femoral-to-below knee popliteal artery bypass. (A) Pelvic arteriogram demonstrates irregular narrowing of left external iliac artery (large white arrow). (B) Digital subtraction common iliac arteriogram through Balkan sheath re-demonstrates the narrowed segment. (C) Fluoroscopic spot image shows balloon dilation of the stenotic segment. (D) Digital subtraction angiogram after angioplasty demonstrates resolution of lesion with good antegrade flow. (E) Fluoroscopic image shows infusion catheter positioned within the thrombosed bypass. (F) Digital subtraction angiogram obtained after 14 hours of thrombolysis demonstrates minimal flow into proximal portion of bypass. (G–K) Digital subtraction angiogram obtained after 20 hours of thrombolysis shows antegrade flow throughout the bypass and down the anterior tibial artery to the foot.

(tPA; Alteplase, Genentech, San Francisco, CA) was laced through the length of the graft. The catheter was exchanged for a 20-cm-long infusion catheter, which was positioned with the most distal sidehole in the graft and the most proximal sidehole in the common femoral artery. Thrombolysis was initiated at 0.5 mg tPA per hour, with 200 IU/hour of heparin infusing through the sheath. The patient was transferred to the intensive care unit for overnight observation during infusion of thrombolytics.

After 14 hours, the patient returned to the interventional radiology suite and angiography was performed, revealing partial thrombolysis of the graft but no antegrade flow. The patient's symptoms had worsened initially and then im-

proved minimally. The patient returned to the intensive care unit for continued thrombolysis.

After 20 hours, the patient returned to the interventional radiology suite. His symptoms had improved; his foot was warm, and his pain had nearly completely resolved. Repeated angiography showed good antegrade flow in the graft with single vessel runoff to the left foot via the posterior tibial artery. Thrombolysis was terminated at this point.

Discussion

The rationale for thrombolysis in acute thromboembolic occlusion include minimizing damage to the arterial

endothelium, lysing clot in small arteries inaccessible by an embolectomy catheter, achieving more complete clot removal, and simplifying or obviating surgical therapy. Thrombolysis is an excellent therapy for acute thrombosis of bypass grafts such as occurred in this patient. Optimally, it should be performed within 7 days of occlusion in most patients to have the best outcome. Absolute contraindications to thrombolysis include a nonviable limb (i.e., absent motor and sensory function), ongoing hemorrhage, and an intracranial lesion at risk for hemorrhage. It is important to recognize that thrombolytic therapy does not restore flow instantaneously to an ischemic limb, so patients with rapidly progressing or profound ischemia should be considered poor candidates for catheter-directed thrombolysis.

The patient presented in this article had a saphenous vein bypass. Native bypasses are generally often more difficult to treat by catheter-directed lytic therapy compared with prosthetic grafts. As a rule, the more severe the underlying disease process causing acute occlusion, the more difficult it will be to achieve technically adequate thrombolysis. Thus it is generally easier to restore flow in prosthetic grafts (that thrombose more easily than veins) compared with native conduit.

The single most important fact to recognize regarding thrombolysis is that even if completely successful, thrombolysis merely reestablishes the baseline condition. Therefore, after successful thrombolysis, additional therapy (e.g., angioplasty of anastomosis, surgical revision, anticoagulation) typically also must be performed to ensure a durable result. If adjunctive therapy is not performed, repeat thrombosis is likely to be required in short order. The one setting in which such anatomical abnormalities may not be present are in patients with hypercoagulable disorders in which appropriate anticoagulation was not achieved.

In the patient presented here, the etiology of acute thrombosis was presumed to be the irregular stenotic lesion in the ipsilateral external iliac artery (i.e., inflow disease). This lesion was treated before initiating thrombolysis rather than afterward. In my opinion, inflow disease is best corrected prior to initiation of thrombolysis for several reasons. First, to perform thrombolysis, a catheter must be positioned across the lesion, which exacerbates its hemodynamic effect. In some cases with poor outflow, placing a catheter across a tight stenosis to perform thrombolysis may even incite further thrombosis. Second, poor inflow undermines thrombolysis. Poor flow often limits and lengthens therapy and in some cases may prevent successful clot dissolution altogether. In general, complications are most closely associated with infusion duration, so shortening infusion times is desirable. In contrast to inflow lesions, outflow stenoses are usually treated after thrombolysis because they are usually not identified until flow is restored.

Certain technical aspects of the procedure should be noted. First, it is critical to understand the anatomy involved. If a surgical bypass has been performed (which is often the case), it is helpful to discuss relevant anatomy with the

operating surgeon. Second, an up-and-over sheath performs several functions: It prevents catheter kinking, it can be used to administer low-dose heparin, and it can be used to perform follow-up angiography during thrombolysis. The so-called guidewire traversal test is often prognostic. Specifically, if a guidewire cannot be advanced into the thrombosed conduit or vessel, thrombolysis is unlikely to be successful because it usually indicates a chronic organized occlusion. Such "hard thrombus" (i.e., chronic and organized) tends to be resistant to thrombolysis and portends a poor prognosis for endovascular therapy. Finally, in my experience, the most important prognostic indicators for successful thrombolysis are vessel outflow (i.e., good outflow equates to high success) and the ability to easily advance a guidewire through the occluded segment.

Conclusion

Although the risk of major hemorrhage is admittedly higher with thrombolysis compared with surgery, thrombolysis has proven to be at least equivalent to surgery in many patients with acute limb-threatening ischemia and is considered the standard of care for acute peripheral arterial occlusions. If the outflow is robust to the foot, flow can usually be reestablished relatively quickly. As noted earlier, some intervention after clot dissolution is nearly always mandatory to ensure a durable result.

Teaching Points

- Successful thrombolysis merely restores baseline condition so additional therapy (i.e., angioplasty, anticoagulation, surgery) must be performed to achieve a durable result.
- Thrombolysis and surgery are equivalent in most patients with limb-threatening ischemia from acute thromboembolic occlusion.

Recommended Reading

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